CLAIMS

1. A pulsed laser comprising:
a first beam path for establishing at least one short light pulse;
a second beam path for amplifying the short light pulse to obtain at least one high power short light pulse;
a switch for directing the short light pulse from the first beam path into the second beam path; and
a pulse shortening element disposed in the first beam path and absent from the second beam path.

2. The pulsed laser of claim 1 wherein the pulse shortening element comprises a passive pulse shortening element.

3. The pulsed laser of claim 2 wherein the passive pulse shortening element comprises a saturable absorber.

4. The pulsed laser of claim 3 wherein the saturable absorber is a solid state saturable absorber.

5. The pulsed laser of claim 4 wherein the solid state saturable absorber comprises a quantum dot-doped glass material.

6. The pulsed laser of claim 3 wherein the saturable absorber is a liquid saturable absorber.

7. The pulsed laser of claim 2 further comprising a variable switch disposed in the second beam path for outputting the high power short light pulse.

8. The pulsed laser of claim 2 further comprising:
a first mirror;

a second mirror, the first beam path being defined between the first mirror and the second mirror; and

a third mirror, the second beam path being defined between the first mirror and the third mirror;

wherein the first beam path and the second beam path have a segment in common defined between the first mirror and the switch; and

wherein the first beam path and the second beam path have respective separate segments, the passive pulse shortening element being disposed in the separate segment of the first beam path.

9. The pulsed laser of claim 8:

further comprising a variable switch disposed in the common segment for outputting the high power short light pulse;

wherein the first mirror is a high reflectivity mirror;

wherein the second mirror is a high reflectivity mirror; and

wherein the third mirror is a high reflectivity mirror.

10. The pulsed laser of claim 9 further comprising a gain module disposed in the common segment.

11. The pulsed laser of claim 10 further comprising:

a loss module disposed in the separate segment of the first beam path; and

an active pulse shortening element disposed in the separate segment of the first beam path.

12. The pulsed laser of claim 8:

further comprising a variable switch disposed in the separate segment of the second beam path for outputting the high power short light pulse;

wherein the first mirror is a high reflectivity mirror;

wherein the second mirror is a high reflectivity mirror; and

wherein the third mirror is a high reflectivity mirror.

13. The pulsed laser of claim 2 wherein:
the first beam path and the second beam path have at least one segment in common; and
the first beam path and the second beam path have respective separate segments, the passive pulse shortening element being disposed in the separate segment of the first beam path.

14. The pulsed laser of claim 13 further comprising a variable switch disposed in the common segment for outputting the high power short light pulse.

15. The pulsed laser of claim 13 further comprising a variable switch disposed in the separate segment of the second beam path for outputting the high power short light pulse.

16. The pulsed laser of claim 13 further comprising:
a gain module disposed in the common segment;
a cavity dumper disposed in the common segment and having an output beam path;
a loss module disposed in the separate segment of the first beam path; and
an active mode locker disposed in the separate segment of the first beam path;
wherein the passive pulse shortening element comprises a saturable absorber disposed in the separate segment of the first beam path.

17. A pulsed laser comprising:
a resonator cavity having a resonator arm;
a gain cavity having a gain arm;
a pulse shortening element disposed in the resonator arm and excluded from the gain arm; and
an optical switch for controllably selecting between the resonator arm and the gain arm.

18. The pulsed laser of claim 17 further comprising:

a first mirror;

a second mirror, the resonator cavity being disposed between the first mirror and the second mirror, and the resonator arm being disposed between the optical switch and the second mirror;

a third mirror, the gain cavity being disposed between the first mirror and the third mirror, and the gain arm being disposed between the optical switch and the third mirror;

wherein the resonator cavity and the gain cavity share a common segment disposed between the first mirror and the optical switch.

19. The pulsed laser of claim 18 further comprising a variable switch disposed in the common segment for outputting a light pulse.

20. The pulsed laser of claim 18 further comprising a variable switch disposed in the gain arm for outputting a light pulse.

21. The pulsed laser of claim 18 wherein one of the first mirror, the second mirror, and the third mirror is partly transmissive for outputting a light pulse.

22. An active-passive mode locked laser comprising:

a first high reflectivity mirror;

a second high reflectivity mirror, a first beam path being defined between the first high reflectivity mirror and the second high reflectivity mirror;

a loss module disposed in the first beam path;

an active mode locker disposed in the first beam path;

a passive mode locker disposed in the first beam path;

a third high reflectivity mirror, a second beam path being defined between the first high reflectivity mirror and the third high reflectivity mirror and having a common beam path segment in common with the first beam path;

a cavity dumper disposed in the common beam path segment and having an output beam path;

a gain module disposed in the common beam path segment; and

a switch disposed in the common beam path segment at a first end thereof, a second end of the common beam path segment being at the first mirror.

23. The laser of claim 22 further comprising:

a subsequent polarizer disposed in the second beam path.

24. A method for producing a high power pulsed laser beam comprising:

establishing at least one light pulse in a first beam path;

shortening the light pulse in the first beam path to obtain at least one short light pulse, the first beam path comprising a passive pulse shortening element;

directing the short light pulse into a second beam path, the passive pulse shortening element being absent from the second beam path; and

amplifying the short light pulse in the second beam path to obtain at least one high power short light pulse.

25. The method of claim 24 further comprising:

directing the high power short light pulse from the second beam path to form the high power pulsed laser beam.

26. A method of operating a laser to produce a pulsed laser beam, comprising:

establishing light in a resonator cavity of the laser to produce a first light pulse, the resonator cavity comprising a saturable absorber having a saturation level, and the first light pulse having a duration and further having a peak power below the saturation level of the saturable absorber;

amplifying light in the resonator cavity to produce a second light pulse having a peak power above the saturation level of the saturable absorber and a duration less than the duration of the first light pulse;

directing the second light pulse from the resonator cavity into a gain cavity, the gain cavity excluding the saturable absorber;

amplifying the second light pulse in the gain cavity to obtain a third light pulse having a

peak power above the peak power of the second light pulse; and outputting the third light pulse from the laser.